CHAPTER 11

EQUIPMENT MODIFICATIONS

1. MODIFICATION GUIDELINES. UMCS implementation requires modifications to mechanical and electrical systems and their associated instrumentation and controls. Interface to mechanical and electrical systems will require coordination with manufacturer's operating recommendations and site associated equipment/systems operating constraints.

2. INSTRUMENTATION AND CONTROLS. Existing local controls will be removed and replaced with the application of DDC. For supervisory control applications existing local control system equipment will be shown to include modifications required for interfacing with the UMCS. Except for existing time clocks, the existing local loop control system must remain and perform as originally designed for UMCS supervisory control applications. It will be necessary to indicate replacement of controllers to provide capability for remote control point adjustment. The local loop controls will be interfaced so they will operate in a predetermined manner upon UMCS failure. New sensors dedicated for UMCS use must be shown as new rather than reusing existing sensors. When interfacing the field equipment, all existing indicating devices such as gauges and thermometers will be shown as remaining in service for direct digital control applications. The local controller will be replaced but the existing final control element (valve/damper) will operate as originally designed.

3. LOCAL CONTROLLERS UNDER SUPERVISORY CONTROL.

a. Existing local control systems using sensor, controller, and actuator require a controller with CPA port for remote control point adjustment. This will necessitate the replacement of the existing controller without CPA by a new controller with CPA. The CPA will be reset from an analog output.

b. Single input CPA controller. Single input CPA controllers permit remote changing of control points by varying the CPA port value. CPA port value variation must be plus or minus 10 percent of primary sensor span. The controller must include an adjustable setpoint, adjustable gain (proportional band) with field selectable direct or reverse acting action. The controller inputs and outputs must have internal or external gauges for calibration of input and output signals.

c. Two input controllers. Two input controllers permit remote changing of control points by varying the second port input value. Effect of the secondary sensor on the setpoint is adjustable as a percentage of the secondary sensor span, usually 33 to 100 percent of primary sensor span. The controller must include an adjustable set point, adjustable gain (proportional band) with field selectable direct or reverse acting action. The controller inputs and outputs must have internal and external gauges for calibration of input and output signals.

4. CONTROLLER INTERFACES.

a. Typical controller interfaces are shown in Appendix B .

b. A two-position pneumatic override incorporates a three-way solenoid to switch the signal to a predetermined UMCS signal. The UMCS control signal value depends on the operation required and the equipment being controlled. The existing control signal will operate the device being controlled during field equipment panel failure. The UMCS control diagrams (Chapters 8 and 9) will define the failure mode. The electrical equivalent to the two position pneumatic override is accomplished with a relay with Form C contacts.

c. A three mode pneumatic override control incorporates two 3-way EP valves controlled from the field equipment panel electrical output. The operation of the solenoids allows either for the dampers to be

under local control of the mixed air controller or for override to allow for 100 percent outside air supply or minimum outside air supply.

d. Transducers are used for changing pneumatic signals to electric signals and vice versa or for changing a current signal to a voltage signal. Transducers are used in conjunction with sensors and controllers. Electric to pneumatic transducers can be used to convert field equipment panel electrical output signals to pneumatic signal inputs to a local pneumatic control loop or to a pneumatic actuator. Pneumatic to electric transducers can be used to convert local loop pneumatic signals to electric signals inputs to the field equipment panel.

e. A local loop pneumatic controller must be retrofitted with a CPA port for supervisory control. The operation of a local loop 3 to 13 psi air signal on a CPA changes the setpoint plus or minus 10 percent (the percentage will vary depending on the manufacturer of the controller). The UMCS will drive a transducer to change the setpoint from the high to the low (or low to high) setting.

f. The designer will determine the failure mode of operation for each CPA point. In order to fail to high, low, or local loop control, main air is fed through a pressure reducing station to produce fixed pressure input to the three-way EP valve. A similar arrangement will use a Form C relay in lieu of a 3-way solenoid. If the required failure mode is to remain in the last command state, the 3-way EP valve or Form C relay is eliminated and the transducer (on UMCS failure) remains at the last command position.

g. The local electric controllers will have the same functions as the pneumatic controllers described above.

5. TIME CLOCKS. The implementation of UMCS time dependent control programs requires elimination of existing time clocks. The existing time clock start/stop contacts are replaced with start/stop contacts operated from the field equipment panel.

6. SINGLE LOOP DIGITAL CONTROLLERS. Existing single loop digital controllers may have to be replaced with controllers having an EIA 485 serial interface with adjustable data transmission rates up to 19.2 Kbps in order to interface with the UMCS. The controller will provide the UMCS with process values, setpoints, alarms and controller status (local-off-auto) and will allow the UMCS to perform remote controller setpoint adjustment.

7. INSTRUMENT AIR SUPPLY.

a. Existing instrument air supplies must be checked for water and oil contamination. If contamination is present the affected pneumatic lines must be replaced and tested prior to UMCS operation. All other devices in the local control loop that have been contaminated must be replaced.

b. The instrumentation air compressor must be oil free. Duplex air compressors are recommended.

c. The instrumentation air supply must have an air drier. Filtration must be provided before and after the air dryer.

d. Air filters must be installed with bypass and isolation valves to permit filter replacement without instrument air supply disruption.

e. Pressure switches must be installed for all major supply air branches to detect loss of air supply.

f. Air drying and filtration at buildings must be provided when instrument air enters a building from an outdoor distribution system.

g. The designer must evaluate the cost effectiveness of replacing a damaged instrumentation air system versus replacement of pneumatic control devices with electric devices (e.g. actuators, controllers).

8. ELECTRICAL EQUIPMENT.

a. Existing equipment being connected to the UMCS will require the installation of disconnect switches or locking starters within sight of the controlled equipment as required by NFPA 70.

b. Spare electrical circuits may be locally available to supply power to UMCS equipment. If these circuits do not exist, or are inadequate for the intended service, new panels or circuit breakers will be required.

9. SUBSTATIONS. Selection and installation of current and voltage transducers for UMCS must be coordinated with the facility and with the equipment manufacturer. Placement of transformer winding temperature sensors must also be coordinated with the manufacturer.

10. SWITCHGEAR. UMCS can monitor the status of electrical distribution switchgear equipment such as:

a. Circuit breakers.

b. Breaker over current trip relays.

c. Tie breaker.

If there are no spare contacts in the switchgear monitoring relays, interposing relays must be provided. Interposing relay kits must be obtained from the original breaker manufacturer. The UMCS will not perform switchgear control functions. These functions may be provided by a Supervisory Control and Data Acquisition (SCADA) system.

11. EMERGENCY GENERATOR. The remote start/stop of emergency generators must be coordinated and reviewed with the installation electrical engineer and with the generator manufacturer. The UMCS will monitor generator status and common alarms either from available contacts at the generator control panel or by means of interposing relays in series with existing control panel status and alarm indicating lights. Generator main fuel storage and day tank level sensors may have to be replaced for the measurements to be monitored by UMCS.

12. MOTOR STARTERS. Starter control circuits must be modified for UMCS interfacing. Typically, existing momentary type starters require parallel starting contacts and series stop contacts, while starters with on/off and hand-off-auto (HOA) switches will require maintained contacts in series with the local automatic control device. Start/stop switches will be replaced with HOA switches. New starter control circuits interfaced with a UMCS for controlling equipment from the UMCS are shown in Appendix B. Since a push-button control circuit requires magnetically operated contacts for momentary operation, latching relays cannot be used. During field equipment panel failure, the controlled equipment remains in the last commanded state. No definitive failure mode can be designed with push-button control circuits. The HOA and start-stop selector control circuits allow magnetically held relays or latching relays to be used for contact operation, depending on the required failure mode. Latching relays will be used when the design requires equipment to remain in the last commanded state during a field equipment panel failure. Magnetically held, normally open relays will be used when the required failure mode is off (or an open circuit), and magnetically held, normally closed relays will be used when the required failure mode is on (or a closed circuit). The design requires definition of the failure mode during a field equipment panel failure for all types of starter circuits. Magnetically held or latching relays will be selected to provide the required failure mode operation. A magnetically held relay requires one DO to control it, while a latching relay requires two DOs to control it.

13. MECHANICAL EQUIPMENT.

a. Piping systems which require addition of flow measuring devices will have pump characteristics verified to determine that any additional pressure drops will not affect the system performance.

b. New valves required to implement UMCS application programs will include installation of any isolation valves needed to provide for valve maintenance and service. Valves for UMCS include chilled water valves, hot water valves, and steam valves. Two position valves installed in steam lines will be provided with bypass lines or other means to keep sufficient heat in the piping to prevent thermal shock when the valves are reopened. Operators installed on steam line valves will have the capability for manual operation, such as a handwheel. Pumps will be added and piping modified to zone particular areas for night setback and summer-winter operation, depending on the site specific requirements. For example, domestic hot water pumps would continue to operate during the summer while space heating pumps would be shutdown.

14. CHILLERS.

a. Chiller enable/disable and multiple chiller selection by UMCS must be coordinated with the installation following the chiller manufacturer's guidelines and system specific operating constraints.

b. The implementation of UMCS applications such as chiller water temperature reset and condenser water temperature reset require interfacing with existing controllers which may need to be replaced to provide the CPA function.

c. Monitoring of chiller operating parameters can be accomplished either by interfacing with an existing control panel (via a communication interface or a hardwired interface) or by adding specific UMCS sensors (such as refrigerant pressures). The sensor selection will be made after consulting with the chiller manufacturer. In some cases it may be more practical to install a new chiller control panel provided by the chiller manufacturer than to install UMCS specific sensors.

d. All chiller installations must have refrigerant-specific leak detection monitoring systems that also provide local and visual indication and alarm. The UMCS designer must coordinate with the installation in the selection of the appropriate leak detection system taking into consideration planned phasing out of existing refrigerants and their replacement.

15. BOILERS.

a. Boiler enable/disable (either automatic or manual based on UMCS program outputs) and multiple boiler selection must be coordinated with the installation for the specific needs of the boiler installation and safety codes. Some installations will not allow remote start of boilers.

b. Control of boiler bypass control valves must be coordinated with the boiler manufacturer for reduced flow operation limits.

c. Monitoring of boiler operating parameters can be accomplished by either interfacing with an existing control panel or by adding interposing relays in series with existing boiler monitoring panel annunciator lights for common or specific alarm conditions.

d. Selection and installation of boiler specific flue gas analytical instrumentation must be coordinated with the boiler manufacturer.

16. HVAC.

a. Air handling systems to which the economizer program is applicable must have 100 percent OA intake and relief air capabilities. New OA intakes will be provided for systems which do not have the capability to handle the 100 percent OA flow. New return and relief air fans will also be required to pull the air back from occupied spaces. The cost of HVAC equipment modifications will be compared with the cost savings from the economizer program to determine if the economizer program is cost effective.

b. New HVAC systems may be needed to separate a continuously operating area from an area requiring night setback capability.

c. VAV boxes installed in air distribution ductwork modulate air flow to conditioned spaces, through positioning of an air valve or damper, to control space temperature. In addition to air flow modulation, VAV boxes may include reheat coils and induction fans. Stand-alone VAV boxes are generally equipped with pneumatic or electronic controllers which are interfaced to pneumatic space thermostats or electronic space temperature sensors. If the stand-alone VAV box controls are in poor operating condition, replacement of the controls with box-mounted unitary controllers interfaced to electronic space temperature sensors may provide cost savings and operational benefits. The unitary controllers would be networked together and interfaced to a smart field panel, allowing centralized monitoring, alarm reporting, and setpoint adjustment through the UMCS. The designer will include in the design drawings the location of each new unitary controller and associated temperature sensor. For projects requiring the replacement or addition of VAV boxes, it is often less costly to have the unitary controllers furnished by the UMCS supplier and mounted to the VAV boxes at the VAV box supplier's factory, rather than install the unitary controllers at the construction site.

17. NEW BUILDING PREPARATION. New buildings which must be prepared for UMCS will be designed following current guidelines. The guidelines shall be verified for the following requirements:

a. Installation of UMCS sensors, including wiring from these sensors to a data terminal cabinet.

b. Provision of HOA switches at equipment electrical starters for future UMCS start/stop interface through the auto switch position. HOA switches will be provided with auxiliary contacts for UMCS monitoring.

c. Provision of auxiliary contacts for monitoring of equipment status and common alarm contacts from local control panels.